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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

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Development of USES Aptitude Test Battery
for

Welder, Arc

(welder) 810.884

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Technical Report on Development of USES Aptitude Test Battery

For .....

Welder, Arc (welding) 810.884

S-211

U. S. Employment Service
in Cooperation with
Ohio State Employment Service

July 1966

GATB Study #2619

DEVELOPMENT OF USES APTITUDE TEST BATTERY

For
Welder, Arc (welding) 810.884

S-211

This report describes research undertaken for the purpose of developing General Aptitude Test Battery (GATB) norms for the occupation of Welder, Arc (welding) 810.884. The following norms were established:

GATB Aptitude	Minimum Acceptable GATB, B-1002 Scores
S - Spatial Aptitude	85
M - Manual Dexterity	85

RESEARCH SUMMARY

Sample:

. 49 male arc welding trainees enrolled at the Hobart Welding School in Troy, Ohio.

Criterion:

Welding test results.

Design:

Predictive (test data were collected at the time the trainees entered the course, criterion data at the conclusion of training).

Minimum aptitude requirements were determined on the basis of course and job analysis and statistical analyses of aptitude mean scores, standard deviations, aptitude-criterion correlations and selective efficiencies.

Predictive Validity:

Phi Coefficient = .32 ($P/2 < .025$)

Effectiveness of Norms:

Only 65% of the non-test-selected trainees used for this study were good trainees; if the trainees had been test-selected with the above norms, 76% would have been good trainees. 35% of the non-test-selected trainees used for this study were poor trainees; if the trainees had been test-selected with the above norms, only 24% would have been poor trainees. The effectiveness of the norms is shown graphically in Table 1:

TABLE 1

Effectiveness of Norms

	Without Tests	With Tests
Good Trainees	65%	76%
Poor Trainees	35%	24%

SAMPLE DESCRIPTION

Size:

N = 49

Occupational Status:

Welding Trainees

Work Setting:

Trainees were enrolled at the Hobart Welding School in Troy, Ohio.

School Selection Requirements:

Each applicant completes an application for the school. This application is reviewed by school personnel; there are, however, no specific requirements for entry. No tests are used.

Principal Activities:

The course of study is designed to prepare individuals to perform the job duties as shown in the job summary in the Appendix.

Minimum Experience:

All individuals included in the sample were trainees.

TABLE 2

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age and Education

	Mean	SD	Range	r
Age (years)	21.9	6.9	17-47	-.086
Education (years)	11.6	1.2	5-13	.262

EXPERIMENTAL TEST BATTERY

All twelve tests of the GATB, B-1002B, using IBM answer sheets, were administered at the onset of training.

CRITERION

The criterion consists of welding tests which duplicate standard tests devised by the American Welding Society. Each test weld is inspected by an instructor for contour, extent of fusion, and soundness. Each Trainee is given a pass or fail score for each welding test taken. The criterion consists of the number of welding tests passed. The range was 0-10. These scores were converted to standard scores with a mean of 50 and standard deviation of 10.

Initially, 72 trainees were tested. Those who did not enroll in both arc welding courses or who dropped out prior to completion of the course were eliminated. This reduced the sample from 72 to 58.

All persons who took no tests or for whom criterion data were not available were eliminated from the experimental sample. This reduced the sample from 58 to 49.

Reliability:

Since only one measure of trainee performance was obtained, no estimate of criterion reliability could be made.

Criterion Distribution:		
	Actual Range:	29-65
	Mean:	49.6
	Standard Deviation:	9.0

Criterion Dichotomy:

The criterion was dichotomized into low and high groups by placing 35% of the sample in the low criterion group to correspond with the percentage of trainees considered unsatisfactory or marginal. Trainees in the high criterion group were designated as "good trainees" and those in the low group as "poor trainees." The criterion critical score was 45.

APTITUDES CONSIDERED FOR INCLUSION IN THE NORMS

Aptitudes were selected for tryout in the norms on the basis of a qualitative analysis of job duties and training course activities and a statistical analysis of test and criterion data. Aptitudes G, S, Q and M which do not have a high correlation with the criterion were considered for inclusion in the norms because these aptitudes were judged to be important for job success and the experimental sample had a relatively high mean on aptitudes G, S and M and a low standard deviation on aptitude Q. Tables 3, 4, and 5 show the results of the qualitative and quantitative analyses.

TABLE 3

Qualitative Analysis
(Based on the job analysis, the aptitudes indicated appear to be important to the work performed)

Aptitude	Rationale
G - General Learning Ability	Necessary for learning fundamentals of arc welding, for following oral and written instructions, and for understanding work orders, diagrams, and layouts.
S - Spatial Aptitude	Necessary for interpretation of diagrams and blueprints and for positioning and assembly of workpieces.
P - Form Perception	Necessary for examining welds and for judging color of metal and size of molten puddle during welding.
Q - Clerical Perception	Necessary for locating small imperfections in welds.
K - Motor Coordination	Necessary for accurate guiding of electrode during welding and for set-up of equipment for welding.
M - Manual Dexterity	Necessary for set-up of equipment and in guiding of electrode during welding.

TABLE 4

Means, Standard Deviations (SD), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Aptitudes	Mean	SD	Range	r
G - General Learning Ability	101.8	15.6	62-129	.023
V - Verbal Aptitude	96.3	12.4	70-127	.088
N - Numerical Aptitude	97.2	15.8	56-134	-.032
S - Spatial Aptitude	108.6	17.0	65-143	.101
P - Form Perception	98.3	16.8	61-155	.019
Q - Clerical Perception	96.8	11.1	76-125	-.271
K - Motor Coordination	94.1	15.0	55-120	.117
F - Finger Dexterity	98.0	15.3	69-134	.034
M - Manual Dexterity	99.7	18.6	58-134	.169

TABLE 5

Summary of Qualitative and Quantitative Data

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Data									
Important	X			X	X	X	X		X
Irrelevant		X							
Relatively High Mean	X			X					X
Relatively Low Standard Dev.		X				X			
Significant Correlation with Criterion									
Aptitudes to be Considered for Trial Norms	G			S		Q			M

DERIVATION AND VALIDITY OF NORMS

Final norms were derived on the basis of a comparison of the degree to which trial norms consisting of various combinations of aptitudes G, S, Q, and M at trial cutting scores were able to differentiate between the 65% of the sample considered good trainees and the 35% of the sample considered poor trainees. Trial cutting scores at five point intervals approximately one standard deviation below the mean are tried because this will eliminate about 1/3 of the sample with three-aptitude norms. For two-aptitude trial norms, minimum cutting scores of slightly more than one standard deviation below the mean will eliminate about 1/3 of the sample; for four-aptitude trial norms, cutting scores of slightly less than one standard deviation below the mean will eliminate about 1/3 of the sample. The Phi Coefficient was used as a basis of comparing trial norms. Norms of S-85 and M-85 provided a high degree of differentiation for the occupation of Welder, Arc 810.884. The validity of these norms is shown in Table 6 and is indicated by a Phi Coefficient of .32 (statistically significant at the .025 level).

TABLE 6

Predictive Validity of Test Norms S-85 and M-85

	Nonqualifying Test Scores	Qualifying Test Scores	Total
Good Trainees	7	25	32
Poor Trainees	9	8	17
Total	16	33	49

Phi Coefficient (ϕ) = .32 Chi Square (X^2) = 4.861

Significance Level = $P/2 < .025$

DETERMINATION OF OCCUPATIONAL APTITUDE NORMS

The data for this study met the requirements for incorporating the occupation studied into OAP-27 which is shown in Section II of the Manual for the General Aptitude Test Battery. A Phi Coefficient of .26 is obtained with the OAP-27 norms of S-80, F-90, M-85.

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FACT SHEET

Job Title: Welder, Arc (welding) 810.884

Job Summary: Welds metal parts together, as specified by layout, diagram, work order, or oral instructions, using electric arc welding equipment: Turns knobs on welding unit to desired amperage. Obtains specified electrode or selects one based on bead and type and thickness of metal. Inserts electrode into portable holder. Connects cables from welding unit to workpiece to obtain desired polarity. Starts power supply to produce electric current. Strikes (forms) arc which generates heat to melt and deposit metal from electrode to workpiece and fuse edges of workpiece. Guides electrode along weld line, maintaining length of arc and speed of movement to form specified depth of fusion and bead, as judged from color of metal and size of molten puddle. Examines weld for size of bead and penetration. May use carbon electrode and manually apply filler rod to supply metal for fusing. May clean or degrease workpiece, using wire brush, portable grinder, or chemical bath. May repair broken or cracked parts, fill holes, and increase size of metal pores.

(This sheet is printed in duplicate. One copy should remain as part of the Appendix in order to complete the technical report. The other copy can be removed by employment service personnel who wish to set up separate fact sheet files.)

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